Urban Testbed Initiative

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Abstract

Subject Terms

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Number of Pages
19

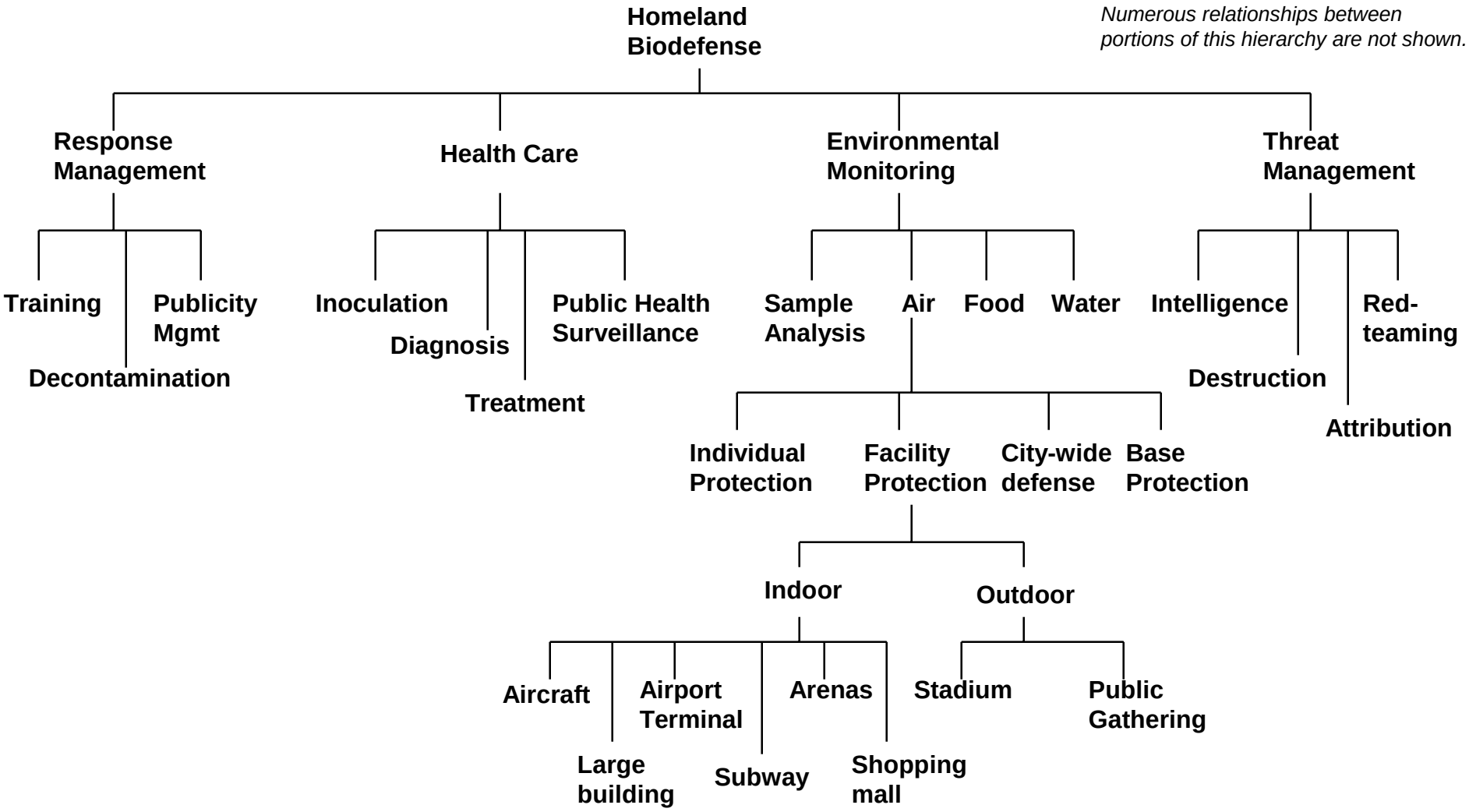
Outline

- Thoughts on Urban Biodefense
- Importance of Testbeds
- MIT LL Urban Testbed Initial Approach
- MBTA subway experiments
- Algorithmic approach
- Future Work

Challenges Associated with Civilian Biodefense

- Any high-density site (city, airport, facility, building) represents a potential target
- Population to be protected is diverse (age, mobility, health)
- No environmental sensing systems will be tolerated that have high false negative or false positive rates
  - If they alarm too much or miss events, they will be ignored
- Current clinical diagnostic technologies and medical infrastructure are not suited to rapid detection of bioagent events
  - Advanced diagnostics (e.g., PCR) use is rare, even in large city hospitals
  - No medical reporting systems are in use that have real-time detection of infectious disease patterns as their objective

Biodefense Components



Biodefense development must be multi-faceted.

Needed Biodefense Investments

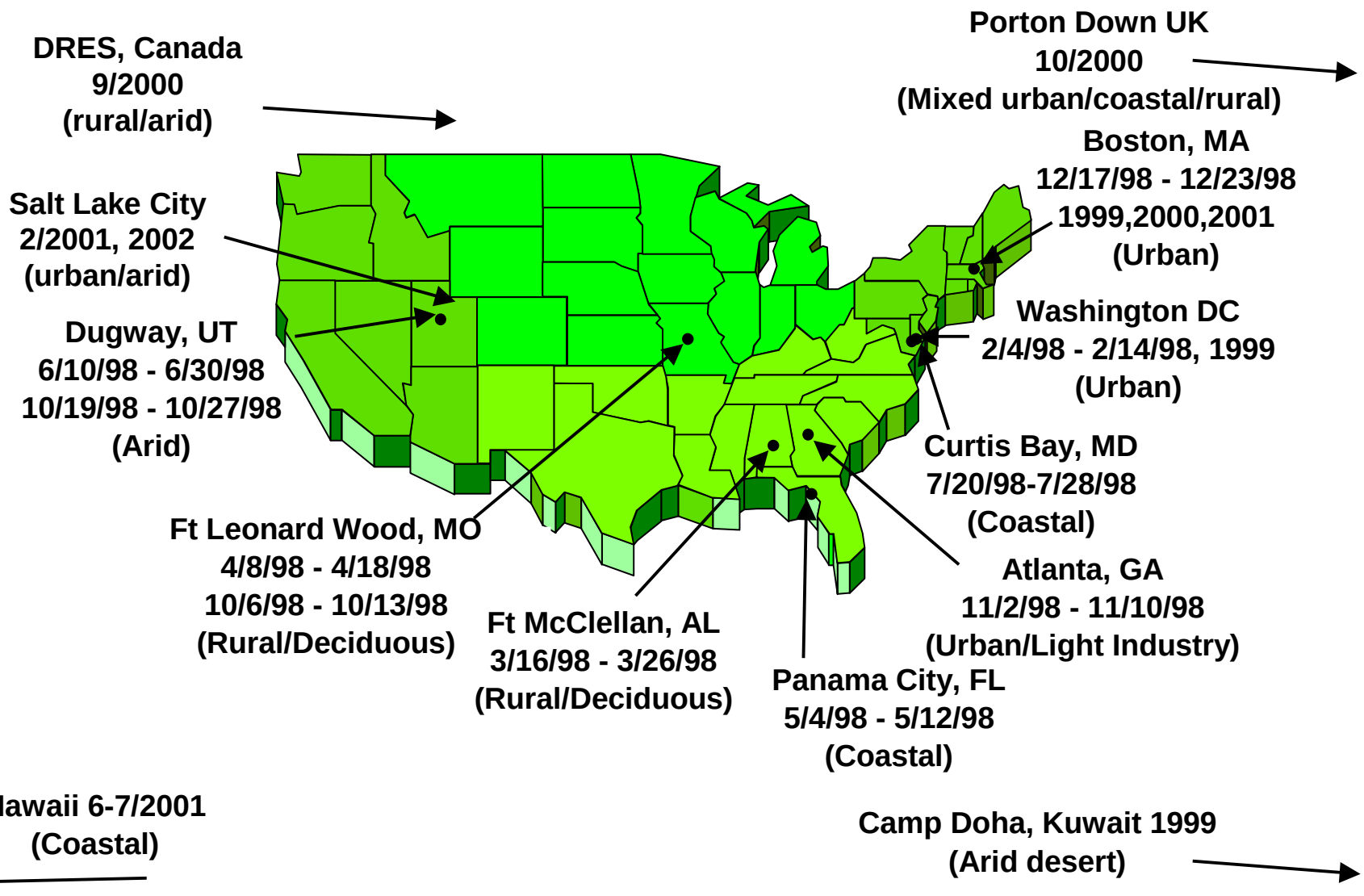
- Point-of-care and public health not well integrated
  - Health care system is the current detector
- System (multi-sensor) environmental monitoring development
  - Focus has been on basic technology and devices
- Characterization of environments of high-threat facilities
  - Sensor technology not universally applicable
  - Helps to set requirements
- Large-scale urban protection
  - Sparse sampling/sensing
  - Low probability event with catastrophic consequences (akin to nuclear detonation)
- Red-teaming

Environmental Monitors

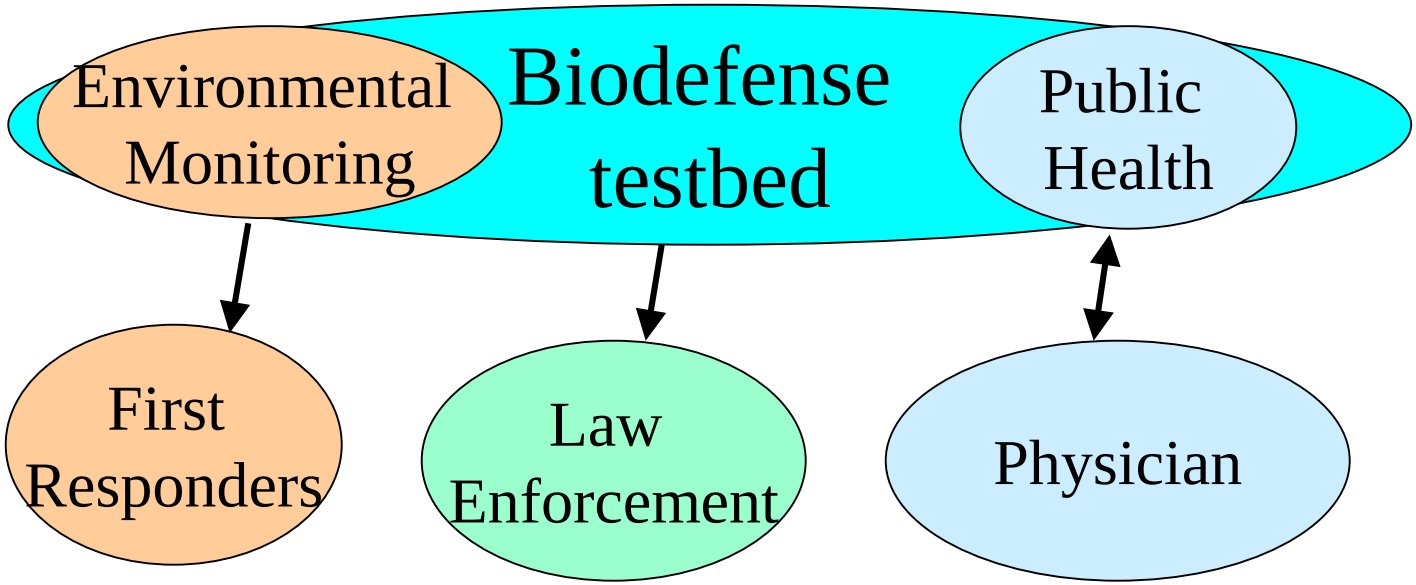
- DoD environmental monitors designed for outdoor force protection
  - High sensitivity preference
  - Current cost prohibits mass-production
  - Unproven performance in urban or indoor areas where air is filled with interferents

- Urban Civil Protection has markedly different requirements from military use
  - Low false alert rate and low cost a priority
    - Lower sensitivity partial solution may be preferred
  - Wide variation in environments (e.g. stadium vs. subway)
    - Densely populated areas add to natural biological interferents
    - Airflow, HVAC are important design considerations

BAWS III Background Measurement Campaign



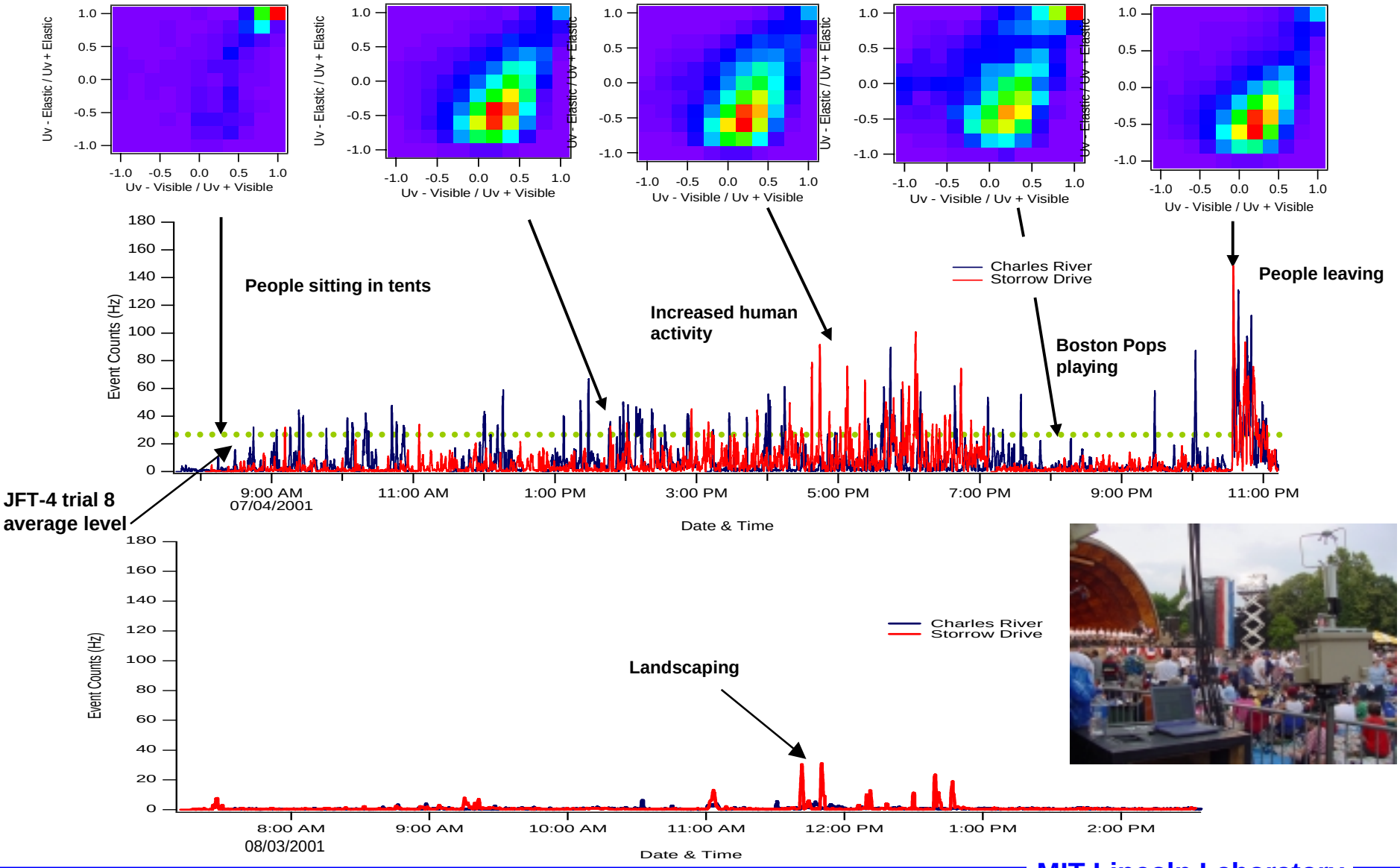
Testbeds as an Important Development Tool



Testbeds are needed for both public health and environmental monitoring systems

- Understand the problem and set system requirements
- Improve training
- Infuse emerging technologies in realistic settings
- Understand unique environments of various facility types

BAWS July 4,2001 Esplanade Measurement



MIT/LL Urban Testbed Project Goals

- **Define a system architecture for facility defense using environmental monitors**
- **Understand the natural air composition and the response of existing instruments in those facilities**
- **Develop decision logic methodology that is extensible to other urban defense problems**

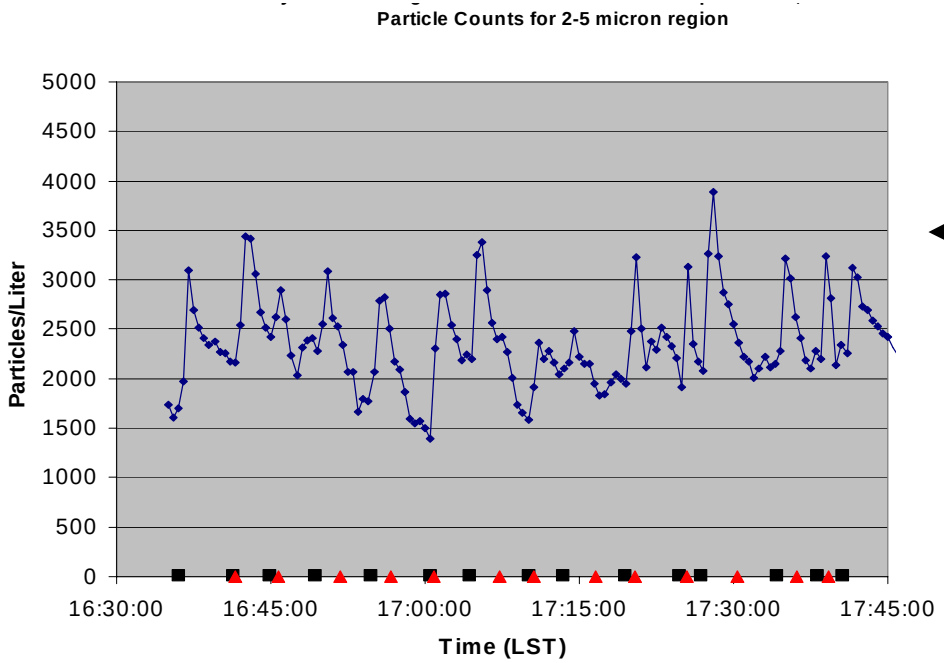
Urban Testbed Status

- Project funding began in June, 2001
- Coordination with Boston-area authorities for the past 1-2 years
  - MA Bay Transportation Authority (MBTA), Boston Emergency Management Authority (BEMA),
    MA Emergency Management Authority (MEMA),
    MA Dept of Public Health, National Guard, Logan airport, others
- BAWS measurements at Boston Marathon, July 4th celebration
- Measurements in MBTA subway station; sensors being installed in a station.
  - Particle counters, airflow, temperature, humidity, train motion.
  - Periodic measurements in other locations or with sensors that cannot be installed for long periods.
- Develop alerting algorithm approach
- Controlled chamber releases
- Discussing measurements in other Boston locations

Subway Protection Considerations

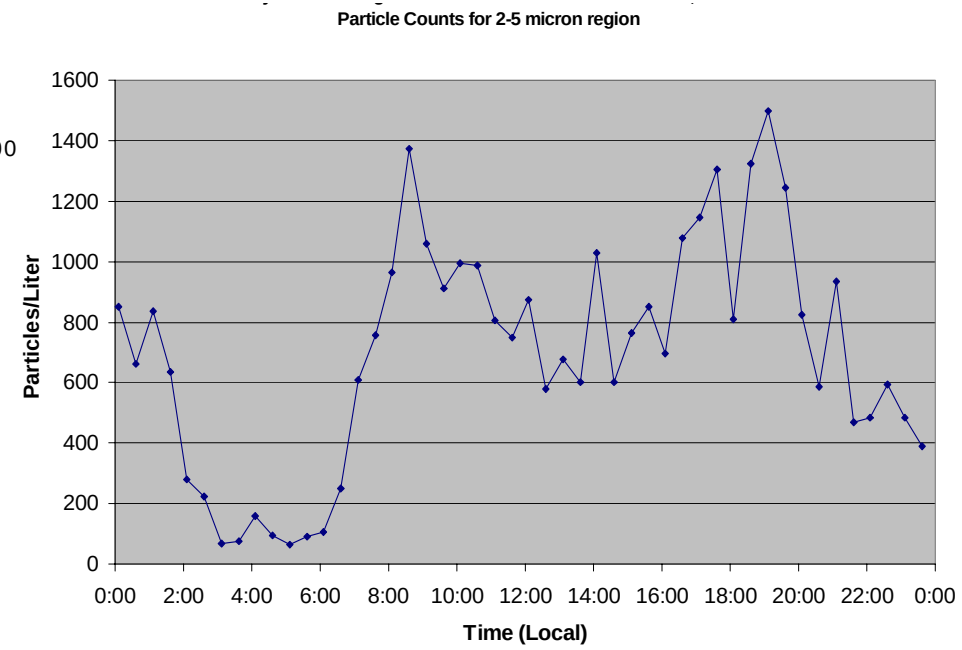
- Threat has been established
  - Aum Shinrikyo Tokyo Sarin gas release
  - Numerous entry points and hiding places
  - Train “piston effect” moves air through the system
- System is spatially distributed
  - Many low cost sensors preferred over few high cost sensors
  - Release point cannot be anticipated apriori
- Important to find dual-use applications for system
- Principal response actions
  - Stop trains (plug tunnels?)
  - Activate vent fans?
  - Evacuate and prevent additional access

Station Particle Counts

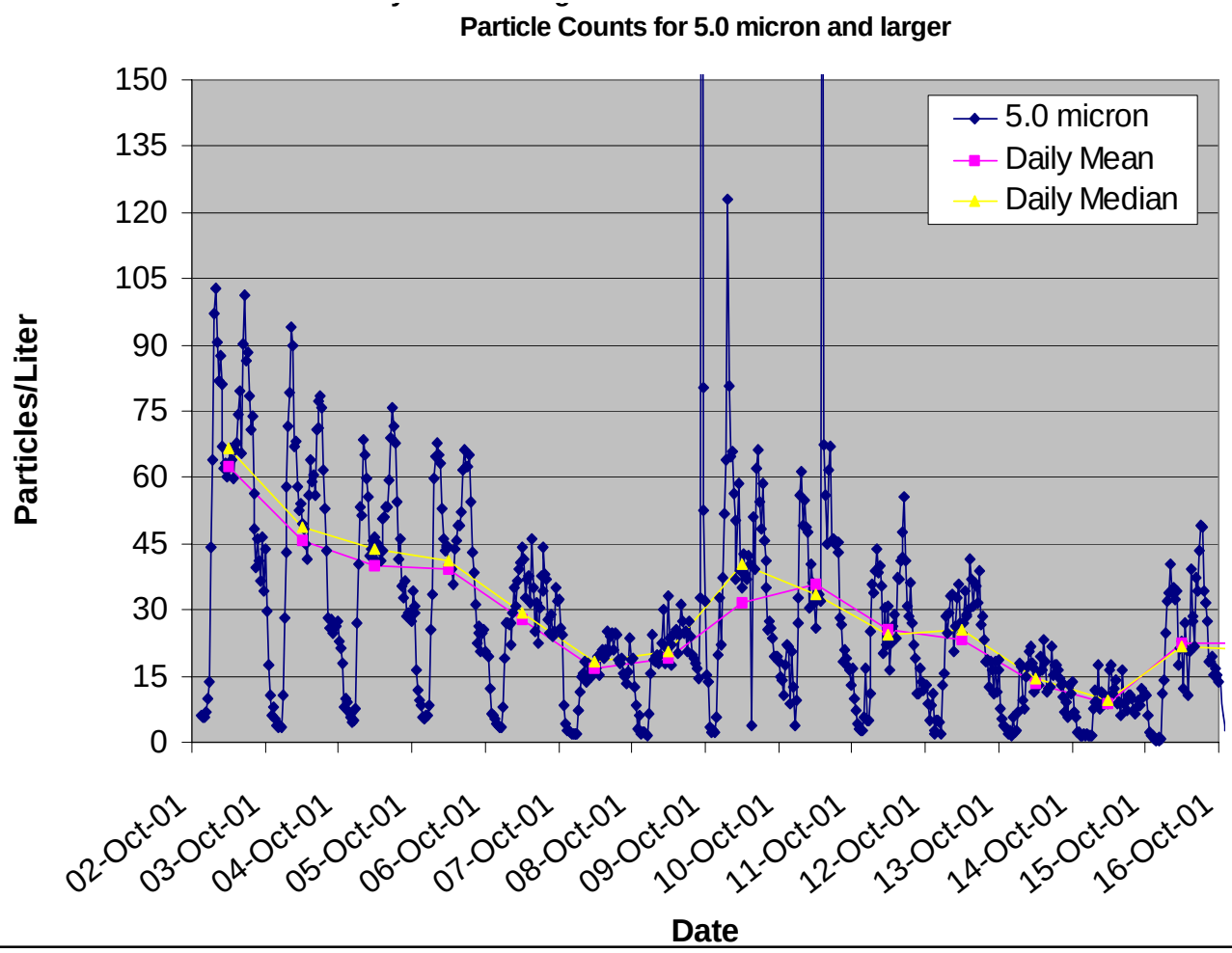


Train Traffic significantly alters particle counts

Diurnal Cycle significantly alters particle counts

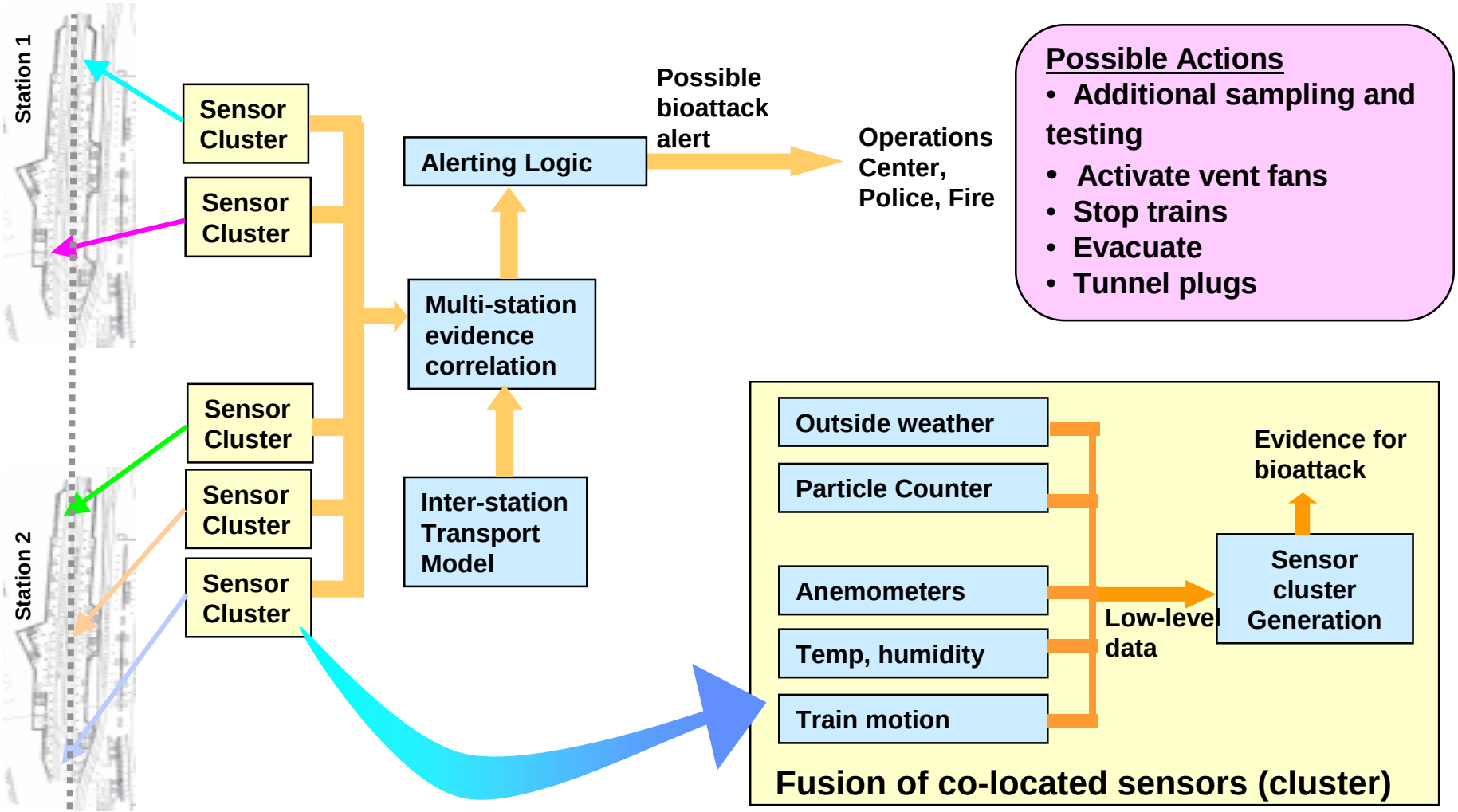


Subway effects on Particle Counter Sensors



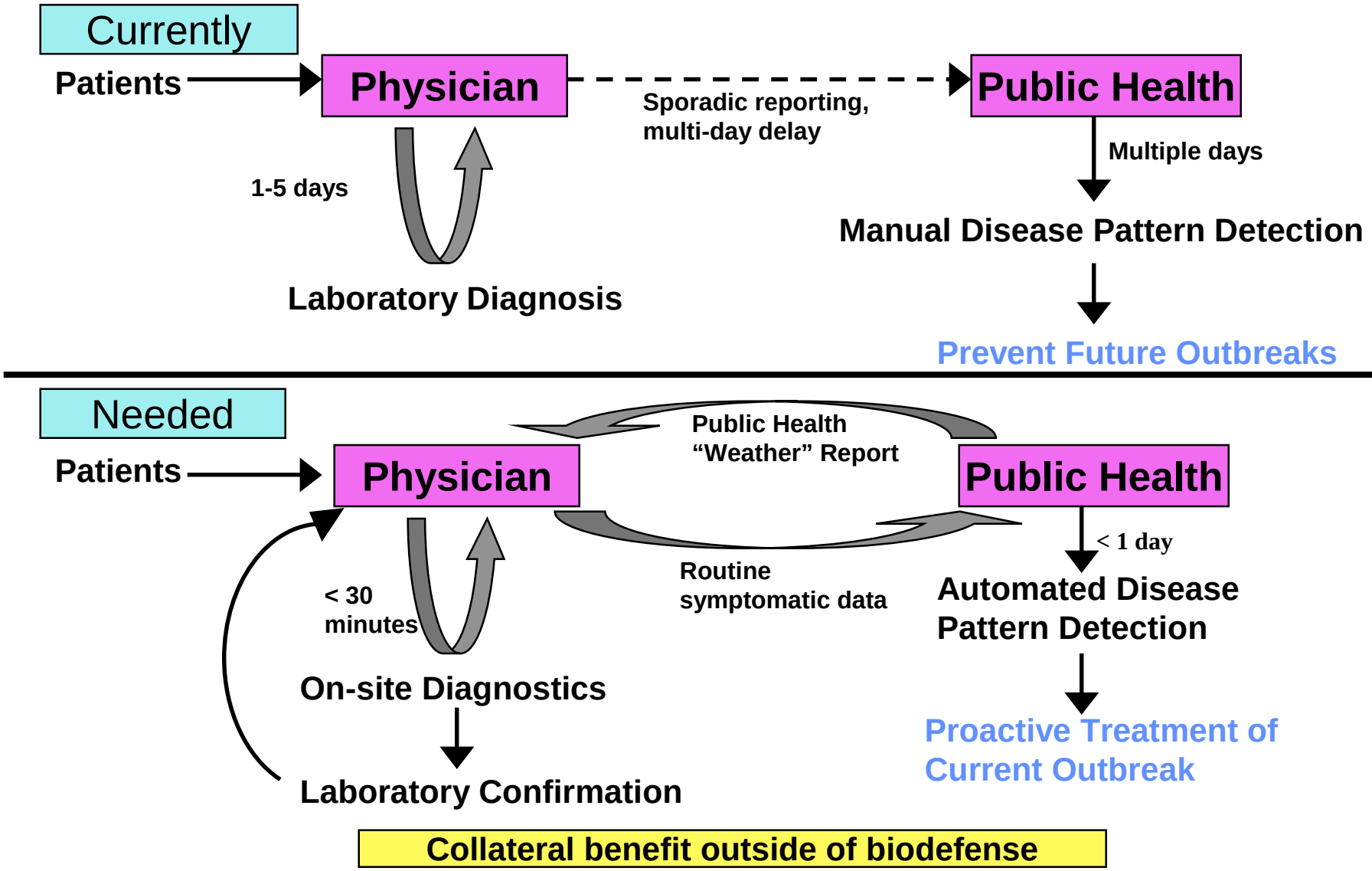
Particle counter sensors degrade quickly due to laser optics contamination. Full instrument sensitivity regained after cleaning.

Subway Alerting Algorithm Architecture



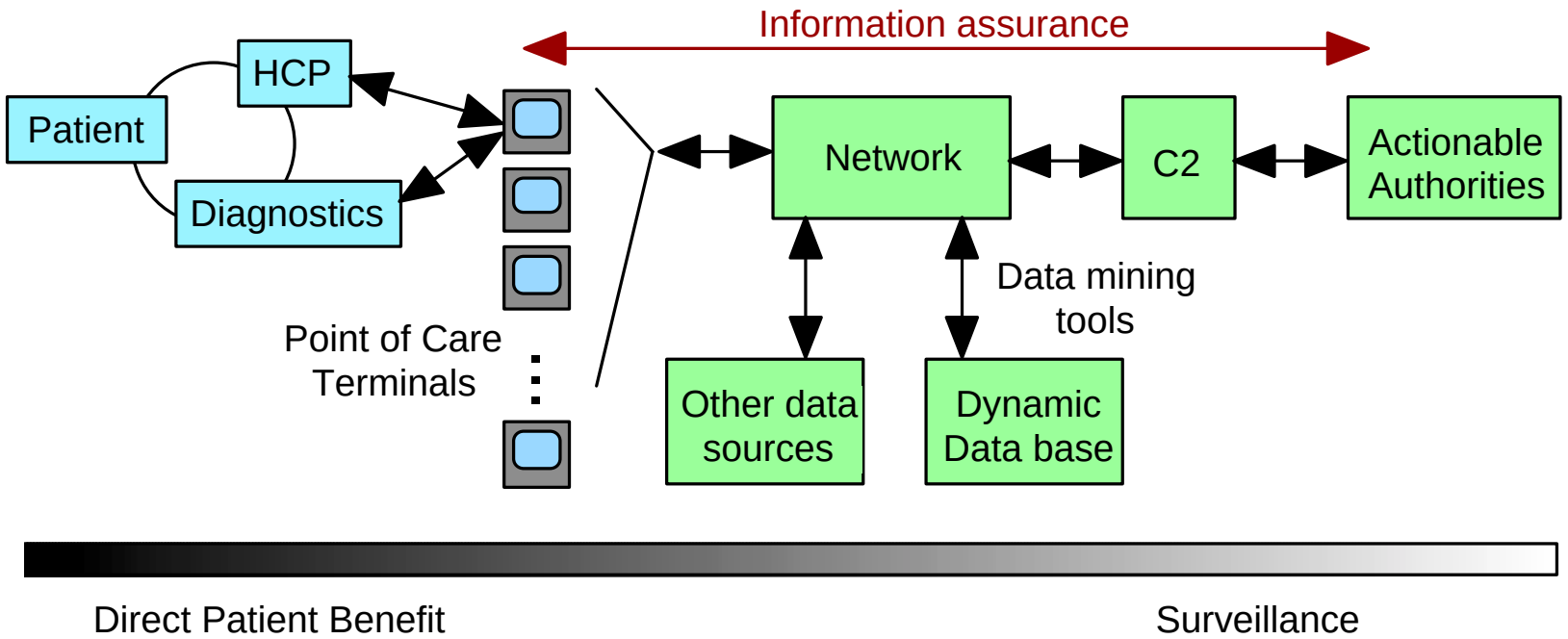
Multiple sensors required to agree and sensitivity reduced to reduce risk of false alert.

Health Care Provider and Public Health Integration

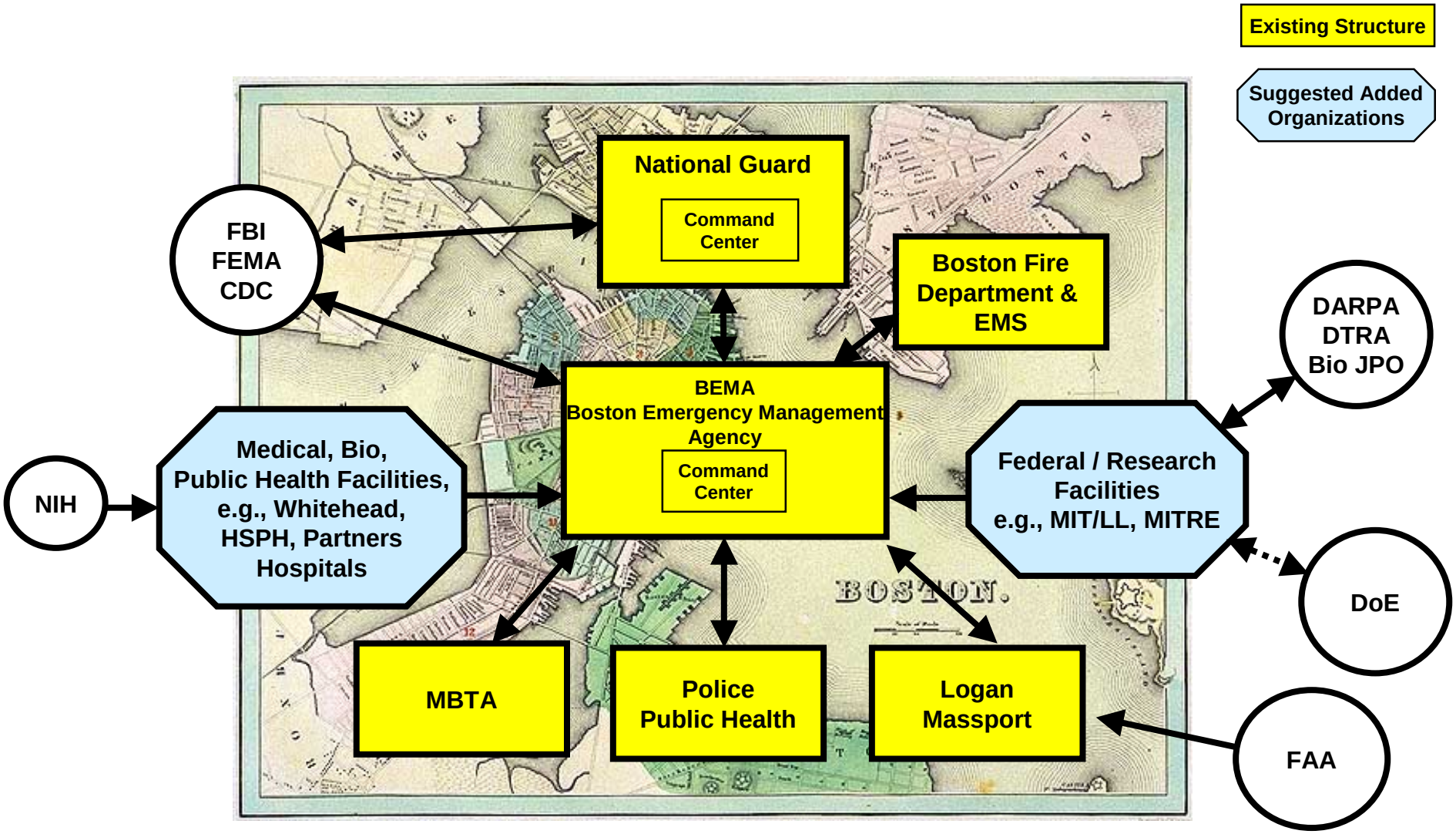


Merging of Health Care with Defense Against Biological Weapons

- **Concept:**
  - **Implement advanced point-of-care diagnostics (including but not limited to gene-chips), into IT networked system**
  - **Enables rapid determination of biological attack**
  - **Benefits natural infectious disease diagnosis, effective treatment**



Boston Area Agencies with Biodefense Responsibilities



Summary

- **Civilian bioterrorism defense requires that the environment of high-threat locations be well understood**
  - **Environment drives sensor & system design**
- **Initial testbed being installed at Boston subway station**
- **Measurements to date point out deficiencies of current sensors & software**
- **Modern recognition/data fusion techniques being applied to data**
- **Measurements at additional Boston threat locations under discussion**